

2019 COOL ROOF REACH CODE

LOW-RISE NEW CONSTRUCTION COST-EFFECTIVENESS ANALYSIS:

City of Palm Springs

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Acronym List

ASR – Aged Solar Reflectance

B/C – Benefit-to-Cost Ratio

BSC – Building Standards Commission

CASE - Codes and Standards Enhancement

CBECC – California Building Energy Code Compliance

CEC – California Energy Commission

CZ – Climate Zone

GHG – Greenhouse Gas

IOU – Investor-Owned Utility

kWh – Kilowatt Hour

NPV – Net Present Value

PG&E – Pacific Gas & Electric (utility)

SCE – Southern California Edison (utility)

SCG – Southern California Gas (utility)

SDG&E – San Diego Gas & Electric (utility)

TDV - Time Dependent Valuation

Title 24 – California Code of Regulations Title 24, Part 6

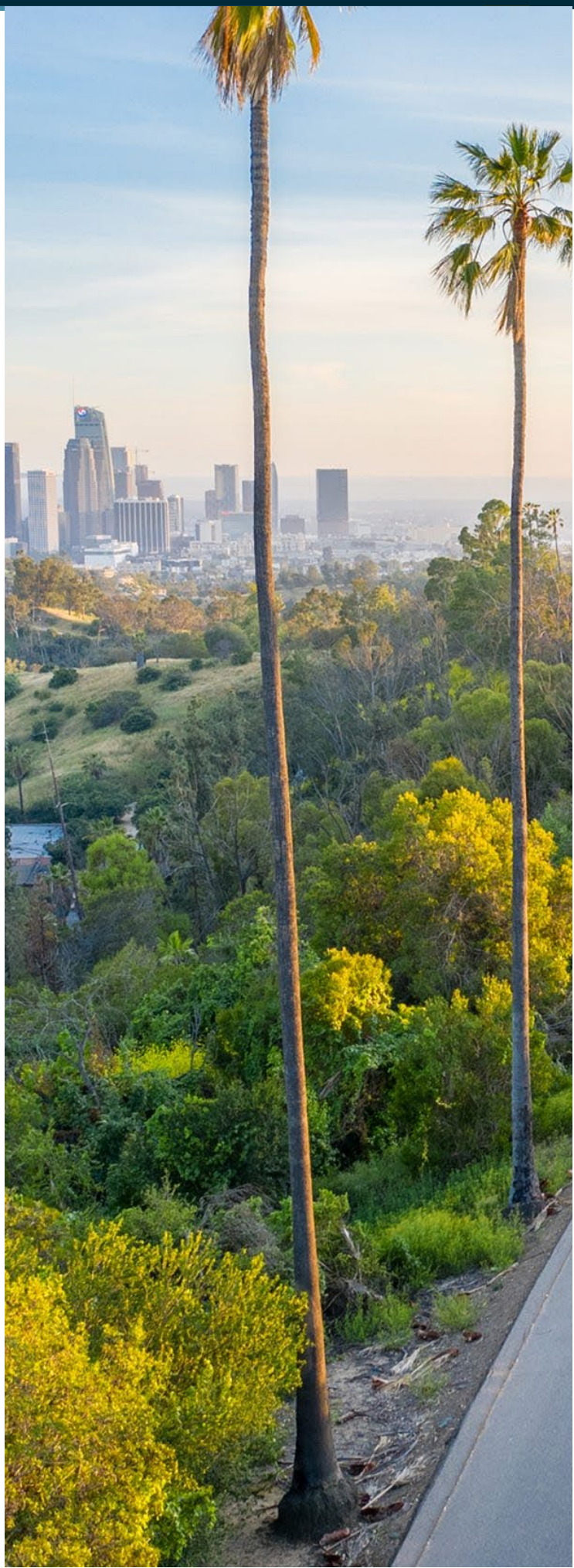


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1 Introduction

The California Codes and Standards Reach Codes program provides technical support to local governments considering adopting a local ordinance (reach code) intended to support meeting local and/or statewide energy and greenhouse gas (GHG) reduction goals. The program facilitates adoption and implementation of the code when requested by local jurisdictions by providing resources such as cost-effectiveness studies, model language, sample findings, and other supporting documentation. Local jurisdictions that are considering adopting ordinances may contact the program for support through its website, LocalEnergyCodes.com.

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (CEC, 2019) is maintained and updated every three years by two state agencies: the California Energy Commission (the Energy Commission) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances—or reach codes—that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost-effective and do not result in buildings consuming more energy than is permitted by Title 24. In addition, the jurisdiction must obtain approval from the Energy Commission and file the ordinance with the BSC for the ordinance to be legally enforceable.

This analysis builds upon the results of the 2019 Cost-effectiveness Study: Low-Rise Residential New Construction (Statewide Reach Code Team, 2019), last modified August 1, 2019, which evaluated the feasibility and cost-effectiveness of upgrade measures in new homes built to the 2019 California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (California Energy Commission, 2018). This report presents results from analysis conducted in response to a request from the City of Palm Springs to evaluate the cost effectiveness of cool roofs in new construction homes as a stand-alone efficiency measure. Results are also reported here for existing single family homes based on the 2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades (Statewide Reach Code Team, 2021)

Cost-effectiveness is reported for California Climate Zone 15. This report was developed in coordination with the California Statewide Investor Owned Utilities (IOUs) Codes and Standards Program, key consultants, and engaged cities—collectively known as the Reach Code Team.

2 Methodology and Assumptions

For the new construction analysis, the same methodology used in the statewide analysis (Statewide Reach Code Team, 2019) is applied to this analysis with the following exceptions:

- Energy analysis was re-evaluated using the most recent approved version of CBECC-Res for the 2019 Title 24 code, CBECC-Res 2019.1.3 SP1.
- Utility costs were calculated based on recent utility costs for Southern California Edison (SCE) and Southern California Gas (SoCalGas). See Appendix 5.1 for details.
- Incremental costs were updated based on more recent information.

Analysis evaluated a steep-sloped cool roof that is rated by the Cool Roof Rating Council to have an aged solar reflectance (ASR) of 0.25 and a thermal emittance of 0.85. This is higher performance than the Title 24 prescriptive cool roof requirement in Climate Zone 15 for an ASR of 0.20 and emittance of 0.75.¹

Incremental costs were updated based on data from the 2022 Codes and Standards Enhancement (CASE) report on Nonresidential High Performance Envelope (Statewide CASE Team, 2020). The report evaluated incremental costs for a 0.25 ASR versus a 0.20 ASR steep-sloped roof. Even though the report analysis was for nonresidential buildings, steep-sloped roofing products for residential and small commercial buildings are the same (large commercial buildings are not typically steep-sloped). Table 1 presents incremental cost data by roofing product. Tile roofing products were not found to have cost variation within the ASR range of 0.20 to 0.25. An incremental first cost of \$0.07/square foot was found for asphalt shingle products. Total lifecycle costs include replacement at year 20 and the value of the remaining useful life of the roof at the end of the analysis period at year 30. The costs for asphalt shingles were used in this analysis to demonstrate the results based on the product with a higher incremental cost.

Table 1: New Construction Cool Roof Incremental Cost

	Tile	Asphalt Shingle
First Cost	\$0.00/square foot	\$0.07/square foot
Effective Useful Life	20 years	20 years
Total Lifecycle Cost	\$0.00/square foot	\$0.094/square foot

No additional analysis was done for the 1,665 square foot existing home. Results are copied directly from the statewide report. The existing home analysis evaluated a steep-sloped cool roof that is rated by the Cool Roof Rating Council to have an ASR of 0.25 compared to an existing non-cool roof with an ASR of 0.10. Table 2 presents incremental cost data for replacing an existing roof assuming an asphalt roofing product and assumes replacement at year 20 and the value of the remaining useful life at year 30. This retrofit measure applies to buildings that are installing a new roof as part of the scope of the remodel; the cost and energy savings associated with this upgrade reflects the incremental step between a standard non-cool roof product with one that is CRRC rated with an ASR of 0.25.

Table 2: Retrofit Cool Roof Incremental Cost

	Asphalt Shingle
First Cost	\$0.32/square foot
Effective Useful Life	20 years
Total Lifecycle Cost	\$0.431/square foot

Refer to the statewide studies for further details.

¹ The base case Standard Design in the CBECC-Res software applies an ASR of 0.20 and emittance of 0.85. Therefore, the energy savings reported are from increasing the ASR from 0.20 to 0.25 and no change in emittance.

3 Results

Table 3 and Table 4 summarize cost-effectiveness of the cool roof measures for new construction and existing homes, respectively. For new homes, upgrading from a cool roof with an ASR of 0.20 to one with an ASR of 0.25 was found to be cost effective for both single family and multifamily buildings. For existing single family homes, at time of roof replacement, upgrading from a non-cool roof to one with an ASR of 0.25 was also found to be cost effective for all vintages.

Table 3: New Construction Cool Roof Cost-Effectiveness Results per Dwelling Unit

Prototype	Fuel Type	Measure Cost	Electricity Savings (kWh)	Gas Savings (therm)	GHG Savings (lb CO ₂ e)	Utility Cost Savings		Customer On-Bill	
						Year 1	Avg Annual	B/C Ratio	NPV
Single Family	Mixed Fuel	\$197	42.6	-0.40	16.28	\$12	\$9	1.40	\$78
	All-Electric	\$197	39.16	0.00	20.22	\$12	\$9	1.39	\$77
Multifamily	Mixed Fuel	\$49	21.6	0.00	9.89	\$6	\$5	2.90	\$93
	All-Electric	\$49	21.5	0.00	9.82	\$6	\$4	2.65	\$81

Note: Values shaded in **red** indicate option is not cost-effective with B/C ratio less than 1. Values shaded in **green** indicate option is cost-effective with B/C ratio greater than or equal to 1.

Table 4: Existing Home Cool Roof Cost-Effectiveness Results per Dwelling Unit

Vintage	Measure Cost	Electricity Savings (kWh)	Gas Savings (therm)	GHG Savings (lb CO ₂ e)	Utility Cost Savings		Customer On-Bill	
					Year 1	Avg Annual	B/C Ratio	NPV
Pre-1978	\$778	883	-1	56	\$280	\$221	7.82	\$5,788
1978-1991		659	-1	65	\$214	\$169	5.96	\$4,209
1992-2010		311	0	26	\$102	\$81	2.85	\$1,568

4 References

- California Energy Commission. (2018). *2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings*. Retrieved from <https://ww2.energy.ca.gov/2018publications/CEC-400-2018-020/CEC-400-2018-020-CMF.pdf>
- Statewide CASE Team. (2020). *Codes and Standards Enhancement (CASE) Initiative 2022 California Energy Code. Nonresidential High Performance Envelope*. Retrieved from <https://title24stakeholders.com/wp-content/uploads/2020/10/2020-T24-NR-HP-Envelope-Final-CASE-Report.pdf>
- Statewide Reach Code Team. (2019). *Title 24, Parts 6 and 11 Local Energy Efficiency Ordinances. 2019 Cost-effectiveness Study: Low-rise Residential New Construction*. Last modified August 1, 2019. Retrieved from https://localenergycodes.com/download/800/file_path/fieldList/2019%20Res%20NC%20Reach%20Codes
- Statewide Reach Code Team. (2021). *2019 Cost-Effectiveness Study: Existing Single Family Residential Building Upgrades*. Updated 2021. Not yet published. Prepared by Frontier Energy.

5 Appendices

5.1 Utility Tariff Details

SoCalGas

Following are the SoCalGas natural gas tariffs applied in this study. Table 5 describes the baseline territories that were assumed for each climate zone.

Table 5: SoCalGas Baseline Territory by Climate Zone

	<u>Baseline Territory</u>
CZ05	2
CZ06	1
CZ08	1
CZ09	1
CZ10	1
CZ14	2
CZ15	1

The SoCalGas monthly gas rate in \$/therm was applied on a monthly basis for the 12-month period ending March 2021 according to the rates shown in Table 6. Historical natural gas rate data was only available for SoCalGas' procurement charges.² To estimate total costs by month, the baseline and excess transmission charges were assumed to be relatively consistent and applied for the entire year based on January 2021 costs.

Table 6: SoCalGas Monthly Gas Rate (\$/therm)

<u>Month</u>	<u>Procurement Charge</u>	<u>Transportation Charge</u>		<u>Total Charge</u>	
		<u>Baseline</u>	<u>Excess</u>	<u>Baseline</u>	<u>Excess</u>
Jan 2021	\$0.39764	\$0.82358	\$1.21382	\$1.22122	\$1.61146
Feb 2021	\$0.36766	\$0.82358	\$1.21382	\$1.19124	\$1.58148
Mar 2021	\$0.36982	\$0.82358	\$1.21382	\$1.19340	\$1.58364
Apr 2020	\$0.20307	\$0.82358	\$1.21382	\$1.02665	\$1.41689
May 2020	\$0.25654	\$0.82358	\$1.21382	\$1.08012	\$1.47036
June 2020	\$0.2758	\$0.82358	\$1.21382	\$1.09938	\$1.48962
July 2020	\$0.26816	\$0.82358	\$1.21382	\$1.09174	\$1.48198
Aug 2020	\$0.26239	\$0.82358	\$1.21382	\$1.08597	\$1.47621
Sept 2020	\$0.25498	\$0.82358	\$1.21382	\$1.07856	\$1.4688
Oct 2020	\$0.25268	\$0.82358	\$1.21382	\$1.07626	\$1.4665
Nov 2020	\$0.3432	\$0.82358	\$1.21382	\$1.16678	\$1.55702
Dec 2020	\$0.36159	\$0.82358	\$1.21382	\$1.18517	\$1.57541

² The SoCalGas procurement and transmission charges were obtained from the following site:
<https://www.socalgas.com/for-your-business/energy-market-services/gas-prices>

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL. P.U.C. SHEET NO. 57456-G
 LOS ANGELES, CALIFORNIA CANCELING Revised CAL. P.U.C. SHEET NO. 57430-G

Schedule No. GR
RESIDENTIAL SERVICE
 (Includes GR, GR-C and GT-R Rates)

Sheet 1

APPLICABILITY

The GR rate is applicable to natural gas procurement service to individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GT-R rate is applicable to Core Aggregation Transportation (CAT) service to individually metered residential customers, as set forth in Special Condition 11.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to income-qualified households that meet the requirements for the CARE program as set forth in Schedule No. G-CARE.

TERRITORY

Applicable throughout the service territory.

RATES

	<u>GR</u>	<u>GR-C</u>	<u>GT-R</u>
<u>Customer Charge</u> , per meter per day:.....	16.438¢	16.438¢	16.438¢
For "Space Heating Only" customers, a daily Customer Charge applies during the winter period from November 1 through April 30 ^{1/2} :	33.149¢	33.149¢	33.149¢

Southern California Edison

Following are the SCE electricity tariffs applied in this study for non-generation rates. The electricity baseline territory used for Climate Zone 15 is 15.

Table 7: SCE Baseline Territory by Climate Zone

Climate Zone	Baseline Territory
6	6
8	8
9	9
10	10
14	14
15	15

Summer Daily Allocations (June through September)

Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	17.2	17.9
6	11.4	8.8
8	12.6	9.8
9	16.5	12.4
10	18.9	15.8
13	22.0	24.6
14	18.7	18.3
15	46.4	24.1
16	14.4	13.5

Winter Daily Allocations (October through May)

Baseline Region Number	Daily kWh Allocation	All-Electric Allocation
5	18.7	29.1
6	11.3	13.0
8	10.6	12.7
9	12.3	14.3
10	12.5	17.0
13	12.6	24.3
14	12.0	21.3
15	9.9	18.2
16	12.6	23.1

Schedule TOU-D
TIME-OF-USE
DOMESTIC
(Continued)

Sheet 12 (T)

SPECIAL CONDITIONS

- Applicable rate time periods are defined as follows:

Option 4-9 PM, Option 4-9 PM-CPP, Option PRIME, Option PRIME-CPP:

TOU Period	Weekdays		Weekends and Holidays	
	Summer	Winter	Summer	Winter
On-Peak	4 p.m. - 9 p.m.	N/A	N/A	N/A
Mid-Peak	N/A	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.
Off-Peak	All other hours	9 p.m. - 8 a.m.	All other hours	9 p.m. - 8 a.m.
Super-Off-Peak	N/A	8 a.m. - 4 p.m.	N/A	8 a.m. - 4 p.m.
CPP Event Period	4 p.m. - 9 p.m.	4 p.m. - 9 p.m.	N/A	N/A

(T)



Southern California Edison
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 70277-E
Cancelling Revised Cal. PUC Sheet No. 69597-E

Schedule TOU-D

Sheet 2

TIME-OF-USE

DOMESTIC

(Continued)

RATES

Customers receiving service under this Schedule will be charged the applicable rates under Option 4-9 PM, Option 4-9 PM-CPP, Option 5-8 PM, Option 5-8 PM-CPP, Option PRIME, Option PRIME-CPP Option A, Option A-CPP, Option B, or Option B-CPP, as listed below. CPP Event Charges will apply to all energy usage during CPP Event Energy Charge periods and CPP Non-Event Energy Credits will apply as a reduction on CPP Non-Event Energy Credit Periods during Summer Season weekdays, 4:00 p.m. to 9:00 p.m., as described in Special Conditions 1 and 3, below:

	Delivery Service Total ¹	Generation ²	
		UG***	DWREC ³
<u>Option 4-9 PM / Option 4-9 PM-CPP</u>			
Energy Charge - \$/kWh			
Summer Season - On-Peak	0.24845 (I)	0.18143 (R)	0.00000 (I)
Mid-Peak	0.24845 (I)	0.10036 (R)	0.00000 (I)
Off-Peak	0.19495 (I)	0.07403 (R)	0.00000 (I)
Winter Season - Mid-Peak	0.24845 (I)	0.12593 (R)	0.00000 (I)
Off-Peak	0.19495 (I)	0.08893 (R)	0.00000 (I)
Super-Off-Peak	0.18859 (I)	0.06926 (R)	0.00000 (I)
Baseline Credit**** - \$/kWh	(0.07228) (R)	0.00000	
Basic Charge - \$/day			
Single-Family Residence	0.031		
Multi-Family Residence	0.024		
Minimum Charge** - \$/day			
Single Family Residence	0.346		
Multi-Family Residence	0.346		
Minimum Charge (Medical Baseline)** - \$/day			
Single Family Residence	0.173		
Multi-Family Residence	0.173		
California Climate Credit ⁴	(29.00) (R)		
California Alternate Rates for			
Energy Discount - %	100.00*		
Family Electric Rate Assistance Discount - %	100.00		
<u>Option 4-9 PM-CPP</u>			
CPP Event Energy Charge - \$/kWh		0.80000	
Summer CPP Non-Event Credit			
On-Peak Energy Credit - \$/kWh		(0.15170)	
Maximum Available Credit - \$/kWh*****			
Summer Season		(0.58115) (I)	

* Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.

** The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.

*** The ongoing Competition Transition Charge CTC of (\$0.00002) per kWh is recovered in the UG component of Generation.

**** The Baseline Credit applies up to 100% of the Baseline Allocation, regardless of Time of Use. The Baseline Allocation is set forth in Preliminary Statement, Part H.

*****The Maximum Available Credit is the capped credit amount for CPP Customers dual participating in other demand response programs.

1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWRBC rate component of this Schedule but instead pay the DWRBC as provided by Schedule DA-CRS or Schedule CCA-CRS.

2 Generation = The Gen rates are applicable only to Bundled Service Customers.

3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.

4 Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 4377-E-A

Decision _____

2C11

Issued by

Carla Peterman
Senior Vice President

(To be inserted by Cal. PUC)

Date Submitted Jan 11, 2021

Effective Feb 1, 2021

Resolution

Get In Touch

The adoption of reach codes can differentiate jurisdictions as efficiency leaders and help accelerate the adoption of new equipment, technologies, code compliance, and energy savings strategies.

As part of the Statewide Codes & Standards Program, the Reach Codes Subprogram is a resource available to any local jurisdiction located throughout the state of California.

Our experts develop robust toolkits as well as provide specific technical assistance to local jurisdictions (cities and counties) considering adopting energy reach codes. These include cost-effectiveness research and analysis, model ordinance language and other code development and implementation tools, and specific technical assistance throughout the code adoption process.

If you are interested in finding out more about local energy reach codes, the Reach Codes Team stands ready to assist jurisdictions at any stage of a reach code project.



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